

AN OPTIMIZATION OF MACHINE SHOP LAYOUT BASED ON SIMULATION SOFTWARE: A REVIEW

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ABSTRACT

Productivity improvement in an industry depends upon many factors such as design, manufacturing process, material handling and inspection. The poor layout design would result in increasing time and cost during the manufacturing, material handling and inspection stage of the production cycle. This paper include the example of different fields in which flexsim software is applied such as aerospace manufacturing, cold chain logistics distribution centers, lean production in industry 4.0, line balancing, layout optimization, freight delivery schedule, supply chain performance, highway freight terminal. It makes efficient adjustments for the system to get a better result which hopes to give a reference for the modeling and simulation for the operation process. In this paper analyses the preliminary output data and finds out the bottleneck as well as idle resources and reviews that implementation of flexsim simulation software results in increased productivity.

KEYWORDS: Flexsim Simulation Software, Lean Manufacturing & Productivity Improvement

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INTRODUCTION

FlexSim is flexible and powerful 3D simulation software used for modeling, simulating, predicting, and visualizing the systems in various industries which include manufacturing, material handling, healthcare, warehousing, mining, etc. The easy to use and user simulation software helps businesses and organizations improve their processes, discover and remove waste, reduce cost, and increase profit.

FlexSim is used in a number of fields:

- Manufacturing field: Production, assembly line, job shop, etc.
- Material handling field: Conveyor systems, AGV, packaging, warehousing
- Logistics and distribution field: Container terminal operation, supply chain design, distribution center work flow, service and storage layout, etc.
- Transportation section: Highway system traffic flow, transit station pedestrian flow, maritime vessel coordination, custom traffic congestion, etc.
- Others section: Oil field or mining processes, networking data flow, etc

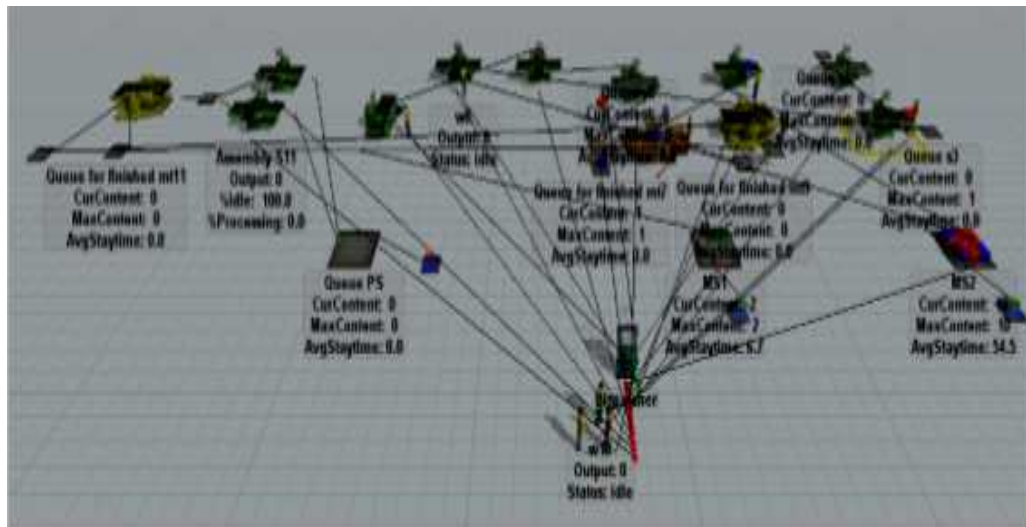


Figure 1: Structure of FlexSim Model [2]

FlexSim has the capability to simulate systems using 3D visualizations and it has a library of objects that users can customize as they build models of their systems. FlexSim creating layouts and models of systems is a breeze through the aid of its drag and drop and point and click functionalities. The analyzing system using the software is made easy. Users will be able to build 3D charts and graphs right in their models, as well as export reports and statistics. Last but not least, FlexSim permits users to identify the potentials of their systems and optimize them through experimentation. [3]

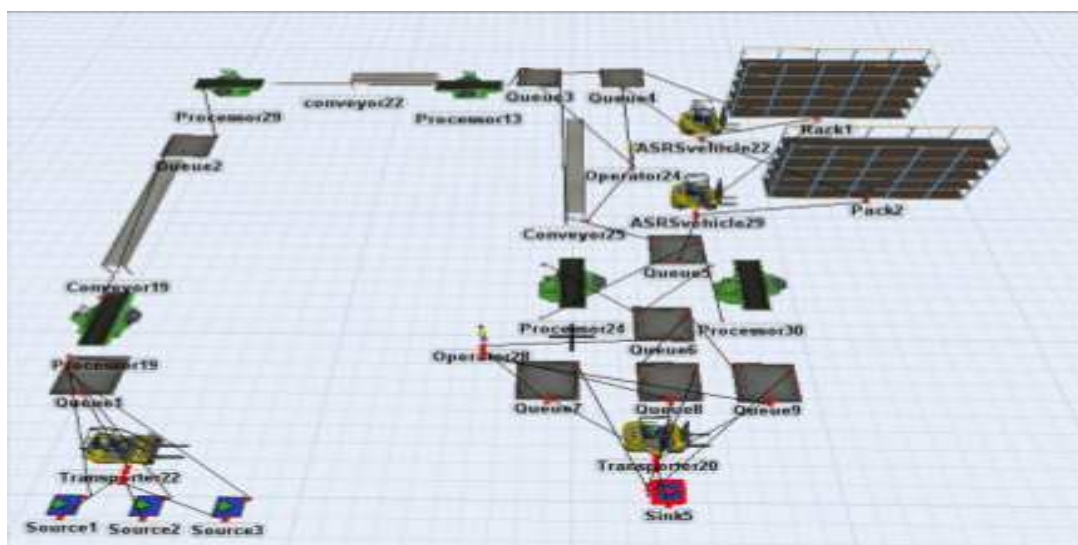


Figure 2: The Optimized Simulation Model [4]

Simulation technique can show specific status and find out the bottleneck as well as idle resource of the system which gives a detail description about actual process and information of this logistics system. The experts mainly focus on the inventory layout of the distribution centre. [5] FlexSim software is a set of computer 3-D image processing technology, simulation techniques, artificial intelligence technology, data handling techniques, etc.

Flexsim is suited to production manufacturing, storage and delivery, transport system and many fields. Flexsim provides original data, entering modeling, operation model to realize simulation experiment and optimizes the system.

LITERATURE REVIEW

Parthasarathy Garre et al.[6]the aim is to identify bottlenecks in the production line of a reputed manufacturing industry. In previous layout, both reciprocating compressor division Reciprocating compressor division & Rotary compressor division models were welded in common child parts assembly area. It was difficult for the operator to separate Reciprocating compressor division and Rotary compressor division assembly parts which were stored in same area. Thus by not following standard operating procedure by operator there was increase in cycle time. The modified layout proposed two different child part assembly area for Reciprocating compressor division and Rotary compressor division which resulted into elimination and unnecessary transportation and reduction in waiting time.[7] 5s implementation provided separate space for storing of sub assembled parts and racks for holding the tools.

X. Zhu et al.[8]the cold chain logistics involves refrigerated and frozen goods in low temperature environment during production, storage, transportation and sales. In order to assure guarantee the quality and performance of the goods. The cold chain logistics distribution centers are facing problems of less automation, more transportation time, inefficient layout planning and complex distribution process. [9] The essential parts of cold chain logistics distribution centers are to reduce processing time in reducing the risk of food spoilage. This paper analyses a cold chain logistics distribution centre and collect the basic data and built the simulation model for operation process. Use of flexsim software helped in obtaining the fundamental data of equipment and workers as well as finding out the bottleneck and idle resources.

U. Sravan Kumar and Y. Shivraj Narayan et al. [10] in a global market achieve higher productivity through manufacturing of superior quality product with less time and cost. Poor layout design is increase the cost and time during the manufacturing, material handling and inspection.[11] The main objectives are identifying the various problems in previous layout and so provide efficient solution of this problem. The previous layout finding the blocking zone and waste area, presence of obsolete machine, improper utilization of space in the layout, etc this existing layout created in AutoCAD in 2D layout. The various objects like machine, waiting areas, material handling equipment, etc are places right areas. Using the collected data and AutoCAD layout is built in flexSim simulation software. Built the simulation model based on propose layout and validate the flexSim model.

Beata Mrugalska et al. [12]Lean production deals with the integration of humans in the manufacturing process, a continuous improvement and emphasize on value adding activities by avoiding waste. A new concept Industry 4.0 creates a smart network of machines, components, properties, products and ICT system to have an intelligent factory. Lean has been recognized as doing more with less. Therefore, it focuses on reducing unnecessary steps in the work process by the elimination of actions that don't add the value to the product or services. Lean covers diverse aspects of the manufacturing right from the initial stage of product life cycle to distribution. It is applied as philosophy and a set of tools to achieve the highest quality, lowest cost and shortest lead time. In the presented paper a review of literature about lean production and Industry 4.0 was presented to show that these two approaches can support each other.[13]

Li-Hong Chen et al.[14] Different technical levels of highway freight terminal need allocation of appropriate facilities such as parking lots, warehouses, loading and unloading areas, roads etc to complete the various operations of vehicles and good in the station. The paper uses the flexSim computer simulation technology combined with AutoCAD and 3dsMax software to simulate the highway freight terminal. In this paper a typical road freight station is used as an example to establish the simulation model and give simulation result of the area ratio.[15] By adding splitter or a synthesizer in the model and running it, you will find wasted facility. By reducing splitter or a synthesizer, blocking

phenomena are founded. Thus effective technical means to decision making for the highway freight terminal planning and construction program are provided.

Emilian Szczepański et al. [16] the delivery schedule in urban areas requires consideration of points of view of not only suppliers, customer but also inhabitants of the city. This is a complex process and requires the appropriate optimization model to ensure the sustainable transportation of cargo in cities. The problem taken in the article is related to a class of vehicle routine problems for which met heuristic method is applied as a solution. The problem of freight distribution in urban areas involves technical, economic and social issue. Solution of such task requires the verification and validation of obtain results. One of the methods can be a simulation analysis. Simulation models are used in a variety of transports mode and in different problems, e.g. to decompose traffic stream on the transport network.[17] A simulation model verifies the delivery schedule and shows the sensitivity of the solution using random data describing the travel time through the connection.

Paul Eric Dossou and Meriem Nachidi [18] in this paper, Due to the low cost of workforce, emerging country has to think about improving their organization for 1being more competitive. Then, industry 4.0 and supply chain 4.0 are important because of the introduction of new technologies, robots, internet of things, automation and computer aided tools for increasing performance in companies. The problem is how to standardize and elaborate processes of improvement and being sure about the results. New technologies are used in terms of production quality, lead time and cost management, carbon and waste management, social and environmental dimensions management.[19] GRAI methodology is used for analyzing companies technically, organizationally by taking into account human aspect, social and environmental dimensions. This paper shows how the company performance could be increase systematically and automatically by using GRAIMOD.

Dorota Stadnickaa et al. [20] in line balancing the main objective are to distribute tasks over the workers and work station to decrease the idle time of machine and operator. To different ways are to solve the problem of a worker task assignment, one is fixed assignment system and other is work sharing system. In the fixed assignment, the assignment policy is designed on the basis of the given knowledge of workers. In the work sharing workers have to be cross trained and they are dynamically shifted from one station to another to balance the workload. [21] The performed analyses give the solution to employ 9 operators who perform the manufacturing process with the use of one piece flow manufacturing system. This will result into manufacturing of a required number of products with the best workers and workstations use as well as a good workload balance.

Table 1: Summary of Literature Review

Sr. No.	Author / Title	Method	Concluding Remarks
1.	Parthasarathy Garre et al. "Applying lean in aerospace manufacturing."	5S implementation	Identify the bottleneck in production line areas with eliminating the unnecessary transportation and reduce time period by 12 minutes.
2.	X. Zhu et al. "A Flexsim based Optimization for the Operation Process of Cold Chain Logistics Distribution Center."	Flexsim simulation software	In fruit and vegetable cold chain logistics, the fundamental data builds on simulation model which find out bottleneck and ideal resources.

3.	U. Sravan Kumar and Y. Shivraj Narayan. "Productivity improvement through optimization of layout using flexsim simulation software."	AUTOCAD and flexsim simulation software	Using collected data and AutoCAD layout, an exact replica of existing layout built on flexsim simulation software.
4.	Beata Mrugalska et al. "Towards Lean Production in Industry."	Information and communication technology system	Creating a smart network for machines, products, components, properties entire value chain have an intelligent factory.
5.	Li-Hong CHEN et al. "Highway freight terminal facilities allocation based on flexsim."	Flexsim combined with AUTOCAD and 3ds max software	The flexsim computer simulation technology combined with AUTOCAD and 3dsMax software to simulate the highway freight terminal.
6.	Emilian Szczepański et al. "Simulation Support of Freight Delivery Schedule in Urban Areas."	met heuristic method	The application model were significantly reduced the cargo delivery problems which focuses only during travel time of selected routes. on the basis of Simulation analysis success probability is 0.8479.
7.	Paul Eric Dossou and Meriem Nachidi "Modelling Supply Chain Performance."	GRAI Methodology	GRAI methodology is used to analyze companies' technical and organizational performance by human aspect, social and environmental dimensions. The performance increased (weighing) from 4869 to 5314 with percentage 9.14% by using GRAIMOD.
8.	Dorota Stadnicka et al. "Work sequence analysis and computer simulations of value flow and workers relocations."	Line balancing	To distribute this task over the workers and work station, decrease the idle time of machine and operator.

SUMMARY AND CONCLUSIONS

FlexSim simulation software is a virtual and discrete object oriented tool as well as powerful tool for modeling, analyzing, visualizing and optimizing any manufacturing layouts. 5S methodology was implemented and increases the productivity of full welding process; child parts assembly station used and total operating cycle time reduced. A new industrial revolution has emerged by creating a smart network between machines, products, components, properties, individuals and ICT systems in the entire value chain to have an intelligent factory. Use of flexSim software helped in obtaining the fundamental data of equipment and workers as well as finding out the bottleneck and idle resources. The industrial application can stabilize & support lean principle also Industrial impact matrix on lean production system gives a framework to start design & develop industry integrated application. Previous layout finding the blocking zone and waste area, presence of obsolete machine, improper utilization of space, etc. are created in AUTOCAD layout and this layout built in flexSim simulation model and best path are created. GRAI methodology Performance could be increase systematically and automatically. On the basis of results, it is found that the number of operators and the queue size strongly affected the working time of operators and workstations.

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